

THE AUK:

A QUARTERLY JOURNAL OF
ORNITHOLOGY.

VOL. XXXV.

APRIL, 1918.

No. 2.

TAIL-FEATHERS AND THEIR MAJOR UPPER COVERTS.

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RECENTLY when examining the pterylosis of a trogon, I noticed that the middle pair of tail-feathers lacked major coverts. This led me to look at several other alcoholic birds and I found that the number and position of the major upper coverts bore a constant relation to the tail feathers. On consulting the literature of the subject, I was surprised to find that the fact had never been recorded, if it had ever been observed. Indeed it is notable how very commonly the tail has been ignored in general works on birds. For example in Beddard's 'Structure and Classification of Birds,' there are sections on bill, feet, wing, etc. but not a line on the tail and in the well-known 'Dictionary of Birds,' there is no article on either "tail" or "coverts"; the article on "rectrices" does not refer to the coverts and the article on "tectrices" assures us that while the wing coverts are of great importance, "the tail coverts need little further attention!" In Coues' famous 'Key to North American Birds,' there is an excellent section on the tail, with an interesting paragraph on the coverts, but the number and position of the major coverts are not mentioned. Even Nitzsch gives no information in regard to the tail coverts and their relation to the rectrices.

In view of this rather surprising gap in our knowledge, it seemed to me worth while to see what data I could acquire in the small amount of time I could give to the subject. It became clear at

once that little could be learned from skins, at least without seriously damaging them. This is no doubt one of the main reasons why our knowledge is so incomplete. Fortunately the Museum of Comparative Zoölogy has a very large and varied collection of alcoholic birds, which thanks to the kindness of the Director, Mr. Samuel Henshaw, and the Associate Curator of Birds, Mr. Outram Bangs, is freely accessible to me. I have thus been able to examine the tails and major coverts of more than a hundred genera of birds, representing most of the larger and more important orders. The results of this hasty and superficial work are given here and are, I believe, of considerable interest and perhaps of some importance.

The major upper coverts of a bird lie in a single series directly above the rectrices. In the vast majority of birds, they are quite distinct from the other coverts, which rise from the posterior part of the spinal pteryla, and are so definitely circumscribed that their number permits of no discussion. In some birds however, notably the loon and the penguin, it is exceedingly difficult to distinguish any particular series of coverts as "major" and one can simply assume that the series next above the rectrices should receive that title. But in such cases, it is hard to determine where the outer end of this series, on each side, is and there is room for considerable difference of opinion. I have seen no case however where I was unable to satisfy myself as to the number of major coverts. In some birds, notably the woodpeckers, a series of contour feathers on the sides of the pygidium is continuous with the series of major coverts, and in such cases there is again some trouble in definitely limiting the covert series.

The relative position of covert and rectrix shows some diversity. As a rule each covert is inserted at the base of its own rectrix and the line of covert-pits (on a plucked bird) is parallel to the series of rectrix-pits. But sometimes the two series are not parallel, the outer covert-pits being distinctly further from the rectrices at the corners of the pygidium than near the middle. As a rule, the middle pair of tail-feathers is the largest and they are inserted at a higher level than the others; as a result their coverts are pushed to the outer side. Thus covert 1 does not lie above rectrix 1 but between the bases of 1 and 2 or over rectrix 2, and in some cases, where the middle rectrices are particularly stout as in the Pileated

Woodpecker, covert 1 lies between the bases of rectrices 2 and 3. On the other hand in young birds and sometimes in adults, covert 1 is directly over rectrix 1 and each succeeding covert overlies its own rectrix.

The relative size of the different major coverts is also a matter which shows some diversity, though as a rule covert 1 is largest and the size decreases quite uniformly to the outermost member of the series, which is the smallest. Not infrequently however, at least among water-birds, covert 1 is distinctly smaller than 2, and occasionally, as in the bittern, it is very small. Sometimes the third or fourth covert may be the largest, the second and first about equalling the fifth and sixth. The most extreme case is that of the cormorants, where the three outer coverts are large and well-developed with 6 the largest, 5 smaller and 4 still smaller, while the three inner coverts are much reduced and 1 is the smallest of all.

According to the relative number of coverts and rectrices, birds divide naturally into three groups: (1) coverts and rectrices of the same number; (2) coverts more numerous than rectrices; (3) coverts less numerous than rectrices.

In all normal individuals, the tail-feathers of a bird are arranged in pairs, an equal number on each side of the mid-line of the pygidium. In the following tables therefore the condition on only one side is referred to. The rectrices are numbered from the middle outwards, no. 1 being next to the mid-line. The major coverts are numbered correspondingly. The formula "6-6" indicates that there are six rectrices and six major coverts on each side of the pygidium; "6-4" shows six rectrices but only four coverts while "8-6" shows eight rectrices and six coverts. The number of rectrices is invariably placed first.

It should be clearly understood, and I cannot emphasize the point too strongly, that the statements made here in regard to number and position or size of the coverts and rectrices are based wholly upon my own recent and hasty observations. They are thus liable to correction, particularly with reference to the larger groups. When I say for example that the Passeres have six rectrices and only five coverts, I am not ignorant of the fact that some Passeres have seven rectrices. I merely know nothing about the number and position of the major coverts in such cases, so, for the purpose

of this paper, I ignore them. This statement of my observations is purely introductory and is not intended to be as dogmatic as it sometimes appears.

I. COVERTS AND RECTRICES OF THE SAME NUMBER.

- 4-4. *Crotophaga.*
- 5-5. Trochili. Cyseli. Caprimulgi. Cuckoos. Toucan (*Selenidera*). *Jaçana*. *Botaurus*.
- 6-6. Pici. Columbæ. Most Accipitres. Curassows. Nearly all waders and shore-birds. Cranes. Most terns and small gulls. Cormorants. Gannets. Man-of-war-birds. Petrels.
- 7-7. *Zenaidura*. Gannets.
- 8-8. A single individual of *Lagopus*.
- 9-9. *Tetrao*.
- 10-10. Pelicans. Loons. Penguin.

II. COVERTS MORE NUMEROUS THAN RECTRICES.

Except in some owls and the remarkable case of the toucan given below, the additional coverts are at the base of, or beyond, the outermost rectrix on the side of the pygidium. In owls having 6-7, the extra covert *seems* to be between 4 and 5 but probably this is due only to shifted positions of 5, 6 and 7.

- 5-6. A single individual of *Botaurus*, on one side only.
- 6-7. Owls. Osprey. *Cancroma*. A single individual Flamingo. Some gulls.
- 6-8. Some young owls. Some ospreys. *Anhinga*. Albatross. *Cephus*.
- 6-9. Some individuals of *Cephus* and some albatrosses.
- 7-8. Flamingo. Most ducks.
- 7-9. Some ducks.
- 8-9. Some ducks. Geese. *Fratercula*.
- 8-10. *Dafila*. *Ossifraga*.
- 9-10. Some ducks.
- 10-12. Swan.

5-8, 10 or 11. Toucan (*Ramphastos cuvieri*). This is the most extraordinary case of supernumerary coverts, I have seen. As a rule there are 10 or 11 major coverts in a single, distinct but crowded series. In one individual however I found only 8 coverts and it may be there is considerable individual diversity. Ordinarily there are two coverts over the base of rectrix 2, with none over rectrix 1; covert 3 is between rectrices 2 and 3 while covert 4 is directly over rectrix 3; covert 5 is between rectrices 3 and 4, while covert 6 is over rectrix 4; covert 7 again is between rectrices 4 and 5, and covert 8 is over rectrix 5; coverts 9-11 are on the corner of the pygidium, outside the rectrices. In the individual with only 8 coverts, the indications are that coverts 1, 10 and 11 are missing. A further study of this remarkable toucan is much to be desired.

III. COVERTS LESS NUMEROUS THAN RECTRICES.

In every case examined, the reduction in the number of coverts seems to take place at the outer end of the series, but it is possible that in the Passeres and birds with a similar arrangement, covert 1 is wanting rather than simply displaced. In those unusual cases where there are two coverts fewer than the rectrices, one of the missing coverts is possibly no. 1. The question could probably be answered by examination of large embryos or nestlings of the Guinea-fowl or European Quail.

5-4. Motmot (*Baryphthengus ruficapillus*).

6-5. Passeres. Psittaci. Kingfishers. Trogons. Some small hawks. Rails.

6-4. *Coturnix*. *Cyrtonyx*.

7-6. Coot. Gallinules.

8-7. *Lagopus*.

8-6. *Numida*.

9-8. Pheasants. *Bonasa*.

It will be seen from the above data, that relatively few birds have more coverts than rectrices and these are chiefly natatorial birds. Among land-birds, only the owls, the osprey and the big toucan have supernumerary coverts, while of water-birds there are

the Flamingo, the Anseres, the Snake-bird, the Giant Petrel, albatrosses and auks. In *most groups* of birds, the coverts are of the same number as the rectrices, as shown by the various "picarian" birds, the pigeons, the diurnal birds of prey, the curassows and a few other land birds, and the numerous waders, gulls, terns, petrels, Steganopodes, loons and penguins, among water-birds. There can be little doubt that *most species* of birds have fewer coverts than rectrices, for here we find the bulk of the land-birds, Passeres, parrots, kingfishers, trogons, motmots, most gallinaceous birds and a few small hawks; oddly enough the Fulicariæ alone among water-birds have the number of major coverts reduced.

For future reference and to aid in the further investigation of this subject, it seems desirable to put my observations on record here. I have arranged them under the orders recognized and listed by Sharpe in 1891 because no more recent classification of birds seems to me as generally satisfactory as his. I have examined none of the Ratitæ, Crypturiformes, Opisthocomiformes, Heliornithiformes, Podicipediformes, Eurylaemi or Menuræ.

GALLIFORMES. A large curassow from Brazil (species undetermined) had 6 rectrices and 6 coverts. A fine large *Tetrao* showed 9-9 and a single individual of *Lagopus* showed 8-8. All the other galliformes examined by me showed fewer coverts than tail feathers. In *Numida* the formula is 8-6 and in *Coturnix* 6-4. A single specimen of *Cyrtonyx* also showed 6-4, but the pygidium was injured, so I am not sure of this genus. The other genera¹ examined were *Canachites* (8-7), *Tympanuchus* (9-8), *Bonasa* (9-8), *Francolinus* (7-6), *Phasianus* (9-8) *Orcortyx* (6-5) and *Ortyx* (6-5).

COLUMBIFORMES. The number of major coverts corresponds to that of the rectrices. Their position is on the outer side of the base of each tail-feather at the middle of the tail but soon they lie above the rectrices. The genera examined were *Columba* (6-6), *Ectopistes* (6-6), *Zenaidura* (7-7; on one side in one individual, 7-8), *Melopelia* (6-6) and *Chaemepelia* (6-6).

RALLIFORMES. Three species of *Rallus* and one of *Porzana* show 6-5, and covert 1 is smaller than 2 and sometimes quite small;

¹ For convenience I use the generic names of the 'British Museum Catalogue.'

an unidentified king rail from Brazil showed 6-6. An unidentified coot and a gallinule, also from Brazil, showed 7-6. The position of the coverts is as usual.

COLYMBIFORMES. A loon showed 10-10, with each covert over its rectrix except 1.

SPHENISCIFORMES. A penguin (*Spheniscus*) from Chili showed 10-10, each covert over its rectrix. There is great difficulty in both the loon and the penguin in distinguishing the major from the other coverts, so densely are the feathers crowded on the pygidium.

PROCELLARIFORMES. In *Procellaria*, *Fulmarus* and *Daption* the number of coverts is the same as the number of tail-feathers, 6-6; in one petrel, I found only 5 coverts on one side. But in *Ossifraga* (8-10) and *Diomedea* (6-8 or 9) the coverts are distinctly more numerous than the rectrices. The extra coverts are beyond the outer rectrices.

ALCIFORMES. In *Uria* (= *Cephus*) the formula is 6-8 or 9, and one of the extra coverts may be at the inner end of the series; it is apparently a supernumerary covert in the strictest sense, as it is probably not really homologous with the other major coverts; this is indicated by its small size and its position above rectrix 1 on its inner side. The coverts are seldom over their rectrices, though 1 and 2 generally are; covert 7 is over rectrix 6, but 3, 4, 5 and 6 lie between rectrices. The third or fourth covert is longest, 2 and 1 being decidedly smaller. In *Fratercula*, the formula is 8-9 and the coverts are almost or quite over their respective rectrices; 9 is outside rectrix 8. The third or fourth covert is clearly longest.

LARIFORMES. In *Sterna*, *Rynchops* and a few gulls, the formula is 6-6 but in two large unidentified gulls, it was 6-7 or 6-8; the outer coverts are small and might easily be overlooked. In most gulls covert 1 is a little smaller than 2.

CHARADRIIFORMES.— In *Jacana*, the formula is 5-5 but in *Arenaria*, *Aegialitis*, *Numenius*, *Bartramia*, *Calidris* and *Pelidna*, it is 6-6. I regret greatly I could examine none of the shore-birds having more than 12 rectrices.

GRUIFORMES. In *Grus americana*, the arrangement is 6-6 and each covert is over its own rectrix. Covert 1 is the smallest and 3 is the largest, 2, 4, 5 and 6 being intermediate.

PELARGIFORMES. In *Ibis*, we find 6-6, and the same is true of *Ardea*, *Herodias*, *Nycticorax* and *Tantalus*. *Canceroma* shows 6-7, the extra covert being above rectrix 6. Nitzsch says that he found only *ten* rectrices in *Canceroma*. I had but one specimen and it is unidentified but there are clearly *twelve* rectrices, the number accredited to *Canceroma* in the 'British Museum Catalogue.' The coverts alternate with the rectrices as a rule. In *Botaurus* the formula is 5-5 or occasionally 5-6, suggesting that the reduction in the tail of this genus is quite recent, the extra covert being a relict from the former condition of 6-6. The coverts in the bittern are above the rectrices.

PHOENICOPTERIFORMES. I was fortunate in being able to examine four flamingos. In three, the arrangement was 7-8, but in the fourth it was 6-7. The last specimen had a normal tail but with only twelve rectrices. The first covert is the longest and lies outside the first rectrix.

ANSERIFORMES. The single swan examined showed 10-12, the extra coverts outside the last rectrices and by no means clearly distinct from other contour feathers. In *Branta*, I found 8-9, and also in *Anas*. In *Spatula*, *Cosmonetta* and *Nyroca*, the formula is 7-8 or 9. In *Clangula*, we find 8-9 or 10 and in *Dafla*, 8-10. In *Eristomata*, 9-10 or 11 occur. In all Anseriformes, we find then more coverts than rectrices. In general each covert lies over its rectrix and the additional coverts are at the outer end of the series, where they are often hard to distinguish from the ordinary contour feathers. Occasionally covert 1 lies beside rather than above rectrix 1. In *Clangula*, the series of major coverts is nearer the end of the pygidium at the middle than it is on either side; in other words the covert-series is not parallel to, but divergent from, the rectrix-series.

PELICANIFORMES. In all steganopodous birds, except *Plotus*, the number of coverts corresponds to the number of rectrices; the same is true of their position as a rule. But in relative size there is more diversity. In *Phalacrocorax*, we find 6-6, with the extraordinary condition of the coverts described above (p. 115). In *Sula* we find 6-6 or 7-7, coverts and rectrices corresponding in position and size. In *Fregata*, there are 6-6, with coverts 2 and 3 the longest but 1 not much smaller. In *Phaethon*, I find 7-7 or 8-8,

with 1 the longest. In *Pelecanus*, 10-10 is the arrangement, each rectrix with its own covert above it. In *Plotus*, we find 6-8 or 9 with all the coverts small and narrow and 3 or 4 the longest.

CATHARTIDIFORMES. In a half grown King Vulture (*Sarcorhamphus*) there are six pairs of large rectrices each overlaid very regularly by a major covert. The same is true in the Turkey Buzzard (*Cathartes*) but here covert 1 is smaller than 2 or 3.

ACCIPITRIFORMES. In *Circus*, *Astur* and *Haliaeetus*, we find 6-6 and in the eagle, the first is somewhat smaller than the second. In *Falco albicularis* and *Cerchneis sparveria*, the arrangement is distinctly 6-5 as in Passerine birds. In *Pandion*, on the other hand, we find 6-7 or 8 as in owls; the first covert is a trifle smaller than the second. *Pandion* thus agrees with the anseriform birds in having more coverts than rectrices. The owls are notable among land birds in having the number of coverts exceeding that of the tail-feathers. The first is often smaller than the second as in *Pandion*. In *Bubo*, *Megascops*, *Nyctea*, *Glaucidium*, *Asio* and *Nyctala* we find 6-7. In nestlings of *Bubo* and *Asio*, the arrangement is 6-8, indicating a very recent loss in owls, of the eighth covert.

CORACIIFORMES. The kingfishers (*Ceryle* and at least one unidentified genus) have the passerine arrangement, 6-5, a covert over each rectrix except 1. In the Cypseli (*Chatura*), Trochili (*Archilochus* and 2 or more unidentified genera) and Caprimulgi (*Chordeiles*, *Antrostomus*) the formula is 5-5, a covert nearly over each rectrix. In the only motmot examined, *Baryphthengus*, the formula 5-4 occurs; I have noted it in no other bird. The coverts lie over rectrices 2-5.

TROGONES. The Cuban trogon, *Priotelus*, is the only member of this order available to me and it has the typical passerine arrangement, 6-5.

COCYGES. Some unidentified Brazilian cuckoos agreed with *Coccyzus* in the formula 5-5, each covert agreeing well in relative size and position with the rectrices.

PSITTACIFORMES. All the parrots I examined (*Conuropsis* and at least two different, unidentified genera) agreed in the passerine arrangement 6-5 and showed no peculiarities of their own. Two of the genera lacked the oil-gland.

SCANSORES. Only toucans have been accessible to me, of this

order, and of these only two genera. In *Scenidera*, we find what is probably the typical arrangement, 5-5, the inner coverts alternating with the rectrices but the outer ones lying over them. The extraordinary condition found in *Ramphastos cuvieri* is described above (p. 117).

PICIFORMES. The normal formula for woodpeckers seems to be 6-6, but the sixth covert is small and may be wanting, giving the passerine formula, 6-5. Owing to a line of contour feathers extending down on each side of the pygidium and joining the series of major coverts it is difficult to determine beyond question where the coverts end. In the larger woodpeckers, particularly in *Phlaotomus*, the middle rectrices are so stout the major coverts seem to have been pushed further to the side than usual, so that covert 1 lies between rectrices 2 and 3, covert 2 is between 3 and 4, 3 is over rectrix 4, 4 is over 5 and 5 and 6 are over 6. The genera examined are *Colaptes*, *Melanerpes*, *Dendrocopus*, *Picoides* and *Phlaotomus*.

PASSERIFORMES. All the specimens of passeriform birds examined showed the characteristic 6-5 arrangement, the middle pair of rectrices apparently lacking coverts. Study of developmental material alone can decide whether covert 1 is really wanting or is merely displaced, though it seems probable that the latter is the case. The genera examined, selected quite at random, are *Tityra*, *Xanthoura*, *Turdus*, *Trochalopteron*, *Acanthorhynchus*, *Petrochelidon*, *Bombycilla*, *Piranga* and *Hedymeles*.

The question as to the significance of the data given above is interesting but deductions must be drawn with care from such fragmentary material. The subject is just opened up in this paper and much more work must be done before the importance to be attached to the condition of the major coverts can be determined. It is possible that habits may play an important part in the arrangement of the coverts in some cases. The recent interesting discoveries of Mr. C. W. Beebe regarding the nestlings of toucans and the way they hold their tail suggests that the extraordinary arrangement of the major coverts in *Ramphastos cuvieri* is the possible result of such a habit. Whether there is any phylogenetic significance in the number and character of the major, upper coverts remains to be discovered but it is at least suggestive that the

flamingos are distinctly anseriform in this particular. Finally it may be added that the study of the under tail-coverts has never been undertaken and will probably give results as interesting and suggestive as those afforded by the study of the major upper coverts.

FERRUGINOUS STAINS ON WATERFOWL.

BY FREDERIC H. KENNARD.

SEVERAL years ago at a meeting of the Nuttall Ornithological Club at which I was present, there was an informal discussion among some of the members, regarding the ferruginous suffusion that occurs so frequently on the heads of certain geese, especially the Snow Geese and Blue Geese.

Some of those present seemed inclined to the belief that it might be a phase of adult plumage, while others thought it merely a rusty stain, such as occurs sometimes on the under parts of many of our ducks.

One eminent ornithologist then pertinently inquired, why, if it were a stain, it should be so strictly confined, as a rule, to the forehead and cheeks, with swans as well as geese, and why also it should occur in certain species of waterfowl, but not in others having essentially the same habits and haunts. Another member wisely suggested that a chemical analysis should be made of some of the rusty feathers in question; but nothing further was done at that time.

Personally, I had, without giving much thought to the subject, always supposed this to be a stain caused by extraneous matter deposited in some way by the muddy water in which the birds fed.

During the winter of 1916, my interest in this subject was again awakened, while on a collecting trip after Blue Geese along the Louisiana marshes bordering the Gulf of Mexico, and I have been able, during the past year, to gather data from a number of museums and private collections, which included large series of skins